



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
-----------------	-------------	----------------------	---------------------	------------------

10/757,770

01/14/2004

Zheng Yuan

A7443/T52200

5493

57385 7590 08/21/2007

TOWNSEND AND TOWNSEND AND CREW LLP / AMAT
TWO EMBARCADERO CENTER
EIGHTH FLOOR
SAN FRANCISCO, CA 94111-3834

EXAMINER

STOUFFER, KELLY M

ART UNIT

PAPER NUMBER

1762

MAIL DATE

DELIVERY MODE

08/21/2007

PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary

Application No.

10/757,770

Applicant(s)

YUAN ET AL.

Examiner

Kelly Stouffer

Art Unit

1762

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 06 July 2007.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-28 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-28 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Response to Arguments

1. Applicant's arguments filed 6 July 2007 have been considered but are moot in view of the new ground(s) of rejection.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was

not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

2. Claims 1, 5, 8-11,13-14,19-22, and 24 are rejected under 35 U.S.C. 103(a) as being unpatentable over US Patent number 6218268 to Xia et al.

Regarding claim 1, Xia et al. discloses a method of filling a gap defined by adjacent raised features on a substrate in column 1 lines 32-45. Xia et al. discloses a first step of using a flow of oxidizing, silicon-containing, and phosphorus-containing gas to deposit a BPSG film, or conformal layer, on a substrate and a second step of depositing another film, or bulk layer, using a flow of oxidizing, silicon-containing, and phosphorus-containing gas on a temperature below 500 °C throughout the deposition (column 2 lines 23-60 and columns 11 and 12 et seq.). In order to form the film on the substrate of Xia et al., one of ordinary skill in the art would recognize that these gases must react with one another. The ratios of the gases can be varied at the beginning and end during depositing the conformal layer (Figures 7A and 7B steps 706 and 709 show the ratio being reduced during the deposition, also column 13 lines 4-42) and are constant in the bulk layer. Xia et al. does not explicitly include varying the ratios of gases between the beginning and end of the depositing of the conformal layer. However, Xia et al. teaches that the conformal layer has high doping and hence improved reflow properties, while the bulk layer has lower doping and enhanced film stability (column 2 lines 35-40). In column 3 lines 45-50, Xia et al. describes the two

layers as improving gap filling, thickness uniformity, and film stability over a one-layer film. Different effects of differing ratios of changing gas amounts are shown in Table 1 of Xia et al. Xia et al. notes that higher ozone:teos ratios improves film conformity but has a low deposition rate, and the two-step deposition process reduces overall deposition time (column 11 lines 55-67). The concentration of dopant the second layer or bulk layer protects the conformal layer (column 12 lines 54-58), and most importantly, Xia et al. discloses that the recipe of the conformal layer may be modified to enhance conformation in column 12 lines 51-54. Therefore, in view of the abovementioned benefits of varying dopant, or phosphorous content, in the film it would have been obvious to one of ordinary skill in the art at the time of the invention to vary the phosphorous content during deposition of the conformal layer to improve conformity by routine experimentation and to improve stability of the overall film. Further, "a person of ordinary skill has good reason to pursue the known options within his or her technical grasp. If this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense." (*KSR International Co v. Teleflex Inc.*, 550 US--, 82 USPQ2d 1385(2007)). Therefore, one of ordinary skill in the art who possesses the knowledge of making a graded dopant concentration within a film, would find it within their known options to use a graded dopant concentration to receive the above benefits, knowing that if two layers with two dopant concentrations improved over one layer it follows that one would want a layer made up of many dopant concentrations to improve over two dopant concentrations.

Xia et al. is described above and includes all of the provisions of claim 5 except a capping layer deposited at below 500 °C. Xia et al. teaches that a BPSG layer according to the described invention can be used in any of the dielectric layers 227, 228, and 229 in Figure 2 (columns 9 and 10 lines 55-3). The dielectric layers 227, 228, and 229 are shown to have three separate layers, the topmost of which can be considered a capping layer. It would have been obvious to modify the method of Xia et al. to include another layer in the disclosed process as a capping layer as shown in Figure 2 in order to make a layer that can be used in any dielectric layer in an integrated circuit.

With regard to claims 8-11, Xia et al. includes the recitations as described in the paragraph above, and includes the substrate as a semiconductor (column 1 lines 15-20) and the BPSG layer formed as a pre-metal dielectric layer (column 9 lines 55-60). Again the substrate is maintained at a temperature below 500 °C during deposition, which one of ordinary skill in the art would recognize as below reflow temperature of the silicon oxide and an annealing step is not disclosed. Thus Xia et al. meets all the recitations of claims 8-11, at least as broadly recited by claims 8-11.

With regard to claims 13-14, Xia et al. includes the recitations of claim 13 as discussed above, and discloses the silicon gas as TEOS and the phosphorus gas as TEPO in column 6 lines 15-31. Xia et al. meets all the recitations of claims 13-14, at least as broadly recited by claims 13-14.

All of the elements of claims 19-22 and 24 are disclosed by Xia et al. as described above. Xia et al. meets all the recitations of claims 19-22 and 24, at least as broadly recited by claims 19-22 and 24.

3. Claims 2, 3, 6 and 7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Xia et al. in view of US Patent number 6013584 to M'Saad. Xia et al. is described above and includes making patterned metal over the BPSG layers in column 10 lines 1-12. Xia et al. does not include keeping the temperature at the substrate below the temperature of the silicon oxide or annealing the substrate during patterning. M'Saad teaches that it is not necessary to reflow the film but one can use a chemical mechanical polishing technique to planarize the film before depositing the metal so the temperature would not be raised, and one would assume the temperature would not be raised to reflow temperature when dealing with BPSG films in order to not reach temperatures that are too high for thermal budgets required for advanced pre-metal dielectric layers in smaller geometries (column 2 lines 21-60).

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Xia et al. to include the temperature of the substrate as below the reflow temperature during metal deposition as taught by M'Saad in order to meet thermal budgets required for advanced pre-metal dielectric layers in smaller geometries.

4. Claims 4, 12, and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Xia et al. in view of US Patent publication 2002/0050605 to Jeng. Xia et al. is

Art Unit: 1762

described above and includes a BPSG layer as a pre-metal dielectric layer but does not include a substrate comprising nickel silicide. Jeng teaches using a substrate comprising nickel silicide when depositing a BPSG layer as a pre-metal dielectric layer because nickel silicide is known to have desirable characteristics for reduced line width devices. (Paragraph 0021 lines 12-14 and paragraph 0025 et seq.)

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Xia et al. to include nickel silicide in the substrate as taught by Jeng in order to take advantage of the desirable characteristics of nickel silicide in reduced line width devices.

5. Claims 15-18 and 25-28 are rejected under 35 U.S.C. 103(a) as being unpatentable over Xia et al. in view of US Patent number 6500771 to Vassilev et al. Regarding claims 15, 17, 25, and 27, Xia et al. is described above and includes a method for depositing BPSG that includes an oxidizing, silicon-containing, and phosphorus-containing gas or a plasma. Xia et al. does not include the phosphorus-containing gas flowing after the silicon-containing and oxidizing gas. Vassilev et al. includes a phosphorus-containing gas flowing after a silicon-containing and oxidizing gas in the form of plasma in column 15 lines 34-52 to limit unacceptable dopant migration during processing (column 2 lines 27-33).

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Xia et al. to includes the phosphorus-containing gas flowing after the

Art Unit: 1762

silicon-containing and oxidizing gas in the form of a plasma as taught by Vassilev et al. in order to limit unacceptable dopant migration during processing.

Regarding claims 16 and 26, Xia et al. discloses the chamber pressure to be between 200 and 700 torr in column 13 lines 4-21.

Regarding claims 18 and 28, Vassilev et al. discloses the plasma density to be within a range including 10^{11} ions/cm³ in column 15 lines 63-65.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.

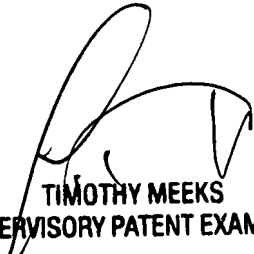
Any inquiry concerning this communication or earlier communications from the examiner should be directed to Kelly Stouffer whose telephone number is (571) 272-2668. The examiner can normally be reached on Monday - Thursday 7:00-5:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Timothy Meeks can be reached on (571) 272-1423. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Kelly Stouffer
Examiner
Art Unit 1762

kms



TIMOTHY MEEKS
SUPERVISORY PATENT EXAMINER